GEOCHEMISTRY OF EPGENETIC DOLOMITE ASSOCIATED WITH LEAD-ZINC MINERALIZATION OF THE VIBURNUM TREND, SOUTHEAST MISSOURI: A RECONNAISSANCE STUDY

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ABSTRACT: A major concern with Viburnum Trend lead-zinc deposits is the nature of the mineralizing fluids. The chemical compositions of secondary recrystallized and sparry dolomites in the Bonneterre and Davis formations were determined to help define the nature of the coexisting mineralizing fluids in the Trend and surrounding areas.

Chemical compositions of the recrystallized host basal dolomite in the lowermost part of the Bonneterre Formation show a general south to north decrease of iron and manganese and an associated increase of strontium. This is consistent with a southern source for the mineralizing fluids. A similar trend of decreasing iron and manganese and increasing strontium upsection in the Viburnum Trend and the back reef indicates that the fluids moved from the underlying Lamotte Sandstone into the Bonneterre Formation.

Low iron and manganese concentrations in the backreef sparry dolomite, as well as relatively constant strontium values in the entire area, suggest the mixing of basal brines with meteoric waters.

A proposed sequence of dolomitization and ore-forming events can be summarized as: (1) dolomitization of the backreef unit by depositional marine or diagenetic waters, (2) updip movement of mineralizing brines from a southern source, possibly the Ouachita-Arkoma Basin, causing epigenetic dolomitization and ore deposition in the Viburnum Trend, and (3) changing of mineralizing conditions due to the mixing in the back reef of principal basal brines with dilute meteoric waters from an eastern source.

INTRODUCTION

A major concern with the Viburnum Trend Mississippi Valley-type lead-zinc district is the source of the mineralizing fluids. Gregg (1985) concluded that mineralizing fluids migrating through the Lamotte Sandstone interacted with the lower Bonneterre Formation, forming an epigenetic basal dolomite. Other recent studies suggest that the formation of many of the Mississippi Valley-type deposits in the central and eastern United States is related to the expulsion of fluids during the Appalachian-Ouachita orogeny (Leach and others, 1984; Kaiser and Ohmoto, 1985; Oliver, 1986).

Other possible regional epigenetic dolomitization events have been discussed in the literature (Mattes and Mountjoy, 1980; Zenger, 1983). The significance of this type of dolomitization in the geologic record may be underestimated. Burial environments may be more favorable for dolomitization than many surficial environments. As temperature increases with depth, dolomite reaction rates increase rapidly (Mattes and Mountjoy, 1980). In addition, magnesium ions can be supplied by basinal waters that react with limestones (Zenger, 1983). For dolomitization to occur in the burial environment, the mass transfer constraints of providing water to the limestone host and driving enough water through the limestone to provide the magnesium mass for the conversion must be overcome (Hardie, 1987). In southeast Missouri, the Lamotte Sandstone provides access of basinal waters to the limestone, and gravity drive models provide a mechanism to move large amounts of water from basins to neighboring platforms (Gregg, 1985). Studies of the trace- and minor-element chemistry of epigenetic dolomites, using the Berthelot-Nernst distribution law, may lead to a better understanding of the movement and nature of sedimentary brines in the epigenetic environment. The Berthelot-Nernst distribution law states that as a mineral grows, trace components will partition between two phases in a characteristic manner, as long as equilibrium is main-

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METHODS

Samples used in this study represent a spatial and/or vertical distribution throughout the region (Fig. 1). Samples were collected from the core stored at the Missouri Department of Natural Resources, Division of the Geological Survey in Rolla, Missouri, from St. Joe Minerals Corporation production cores and mines, and from outcrop locations.

Iron, manganese, zinc, and lead were analyzed using a Jarrell-Ash Atomcomp 975 inductively coupled plasma spectrophotometer. Strontium and sodium analyses were performed on a Perkin-Elmer Model 603 atomic absorption spectrophotometer; strontium was analyzed in the flame absorption mode, whereas sodium was analyzed in the flame emission mode. In order to minimize matrix and interference effects due to high background levels of calcium and magnesium, chemically ultrapure calcium and magnesium carbonates were used in the preparation of standard and blank solutions, matching the concentrations of those two elements to those found in the unknown solutions. Reagent grade hydrochloric acid was used in this study. The same bottle of acid was used in all carbonate digestions and in the preparation of all standard and blank solutions. The effects of parts per billion metal contaminants in the acid were eliminated by zeroing both analytical instruments on blank solutions containing the same concentrations of acid and chemically ultrapure carbonates as the unknowns and standards.

All samples selected for host rock analysis were examined by stereoscopic microscope to determine that they were free of any visible mineralization. The samples were then crushed with a Diamonite™ mortar and pestle and dried overnight at 135°C. Approximately 2 g of material were weighed to 0.1 mg and digested in the 1.25M hydrochloric